Supporting Students with Learning Disabilities in Mathematics

A Focus on the Cycle of Implementation and Monitoring

Keynote Address
Learning for All, K-12

April 29th, 2014

Connie Quadrini, Provincial Math Lead
Engaging in the Math

- Matchsticks are arranged as shown in the figures.

- How many matchsticks are needed to make Figure 10? Show your work and explain your thinking.

- Share your solution(s) with colleagues at your table.
Some Possible Solutions

1 by 1 Counting strategy
Create a model / diagram

Create an explicit pattern rule:
Multiplicative Thinking
Create an algebraic equation

T = (Fig#) x 3 + 3
T = 10 x 3 + 3
T = 33

Extend the pattern:
Additive Thinking
Create a table of values

<table>
<thead>
<tr>
<th>Fig #</th>
<th># of toothpicks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td>7</td>
<td>24</td>
</tr>
<tr>
<td>8</td>
<td>27</td>
</tr>
<tr>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td>33</td>
</tr>
</tbody>
</table>
So Why Do the Math?

- As we engage in collaborative inquiry in mathematics…
  - we need to unpack the mathematics, so that as educators we can…
  - have sharper lenses to interpret student thinking, so that we can…
  - select and implement appropriate evidence / research-based instructional strategies, and…
  - respond to student thinking to move learning forward, which supports our…
  - **SYSTEM MONITORING through IMPLEMENTATION!**
Why Focus on Supporting Students with Learning Disabilities?

- largest group represented within students with Special Education needs, K-12
- large proportion of these students are ‘within’ reach
- shared understanding (special education teachers and classroom teachers of mathematics) of learner profile is needed
- shared understanding how to support students with learning disabilities with various strengths and needs, specifically in mathematics

Ministry of Education, K-12 Capacity Building Series (Fall 2013)
Supporting Students with Learning Disabilities in Mathematics: A Journey

- YCDSB Middle Years Collaborative Inquiry Project (MYMCIP, funded by Student Success / Learning to 18)
  - targeted math content & LD foci, 2010 to present
    - proportional reasoning, 2010-12
    - patterns to algebra, 2012 to present
  - Grades 4-9 teachers, special education teachers, school and system administrators, math and special education consultants
  - 3 families of schools
  - 6 days per teacher
Supporting Students with Learning Disabilities in Mathematics

Inquiry Questions:

1. How does
   - the development of mathematics knowledge for teaching (MKT);
   - and
   - understanding of how students with learning disabilities learn mathematics
   support teachers of mathematics and special education teachers during planning, instruction, and assessment for all students?

2. What is the effect of #1 on achievement of students with learning disabilities?
MYMCIP Framework

- Math content sessions (*From Patterns to Algebra*, Beatty & Bruce) and curriculum unpacking

- Understanding the profile of students with learning disabilities
  - Math-specific simulations
  - IEP unpacking through a mathematics lens

- Co-planning, co-teaching and co-debriefing (multiple cycles)

- Collaborative analysis of student learning (CASL) for students with learning disabilities, with explicit connections made to strengths and needs listed in IEPs
Monitoring – Student Learning

- pre / post assessments (Bruce)
  - multiple choice
  - open response: scoring
    - completion (0, 1, 2)
    - math strategies (ie. counting = C, guess and test = G, additive = A, part/whole = W, multiplicative = R)

- CASL tasks (pre / post)

- clinical interviews
17. Augustina has $9.00 saved in her piggy bank. In addition, she gets paid $6.00 for every hour of yard work she does, which she adds to her savings. Using the table, make a rule that can describe the pattern. How much money will she have saved up once she’s done 10 hours of yard work?

<table>
<thead>
<tr>
<th>Number of Hours of Yard Work</th>
<th>Dollars Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$9.00</td>
</tr>
<tr>
<td>1</td>
<td>$15.00</td>
</tr>
<tr>
<td>2</td>
<td>$21.00</td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

How do you know?

18. Matchsticks are arranged as shown in the figures. If the pattern is continued, how many matchsticks would be used to make Figure 10?

![Figure 1](image1.png)  ![Figure 2](image2.png)  ![Figure 3](image3.png)

Figure 1  Figure 2  Figure 3

Show your work and explain your thinking.
Clinical Interviews

1. Here are some tiles and position cards. Build a pattern for this rule:
   
   Number of Tiles = position # x 3 + 4

Sample #1

\[ \text{Number of Tiles} = \text{position} \times 3 + 4 \]

---

*York Catholic DSB Middle Years Collaborative Inquiry Project, 2012-13*
Clinical Interviews

Number of Tiles = position # x 3 + 4

Sample #2

York Catholic DSB Middle Years Collaborative Inquiry Project, 2012-13
What Did We Learn?

- Toothpick problem
  - ‘perception’ of visual representations of patterns for some students
    - How many toothpicks would there be in Figure 10?

Figure 1 VS Figure 2 VS Figure 3

---

*York Catholic DSB Middle Years Mathematics Collaborative Inquiry Project, 2012-13*
What Did We Learn?

Based on the lessons taught, what was most helpful to you as a learner when learning patterning and algebra / linear relations?

- Approximately 70% of students indicated that using tiles supported them in learning patterning and algebra / linear relations.

- This group included students who, within their IEP, had perceptual reasoning listed as a strength and others who had it listed as a need.
What Did We Learn?

- **Student Voice**
  - manipulatives, specifically square tiles used during lessons, supported students with learning disabilities based on various strengths and needs
What Did We Learn?

- ‘I think with the tiles because you can actually do something hands on...when you do something hands on, it teaches you, it helps us think,...I know this, like ‘cause when you do something hands on, you can remember it, it’s much easier ‘cause you know you’re actually doing it.’ (Student, Grade 5)

York Catholic DSB Middle Years Mathematics Collaborative Inquiry Project, 2012-13
What Did We Learn?

‘I think the tiles really helped to understand...because you could see and lay it out, and you can take the individual parts apart (gestures moving apart) to see [it]...’

(Student, Grade 9 Applied)
Next Steps for Student Learning

- Sharpen the focus on assessment for / as learning
  - Paying attention to student representations / reasoning, and questioning in the moment.
    - ‘How does your representation match this pattern rule?’
    - ‘Tell me what you see.’
    - ‘How does <this> arrangement help you ‘see’ the growing part and the part that stays the same more easily?’
  - Provide opportunities for students to revisit and refine their representation / solutions (e.g. LiveScribe pencasts, EDUcreations / IWB recordings).
Next Steps for Student Learning

- Refine IEPs for students with learning disabilities to ensure greater alignment between summary of psychological assessment, strengths / needs, and ‘accommodations’.

- Provide opportunities for students with learning disabilities to identify ‘accommodations’ that are enabling! → Student Voice
What Did We Learn?
Monitoring – Moving Forward

- pre → refined IEPs
- student voice
- manipulatives ↔ electronic learning tools
The Journey Continues…

- Expanding to include other boards…
  - YCDSB (continued)
  - PVNCCDSB
  - SCDSB
  - YRDSB
Thank You!

Connie Quadrini

Provincial Mathematics Lead

connie.quadrini@ycdsb.ca